ACT 234
Hawaii's Global Warming Solutions Law

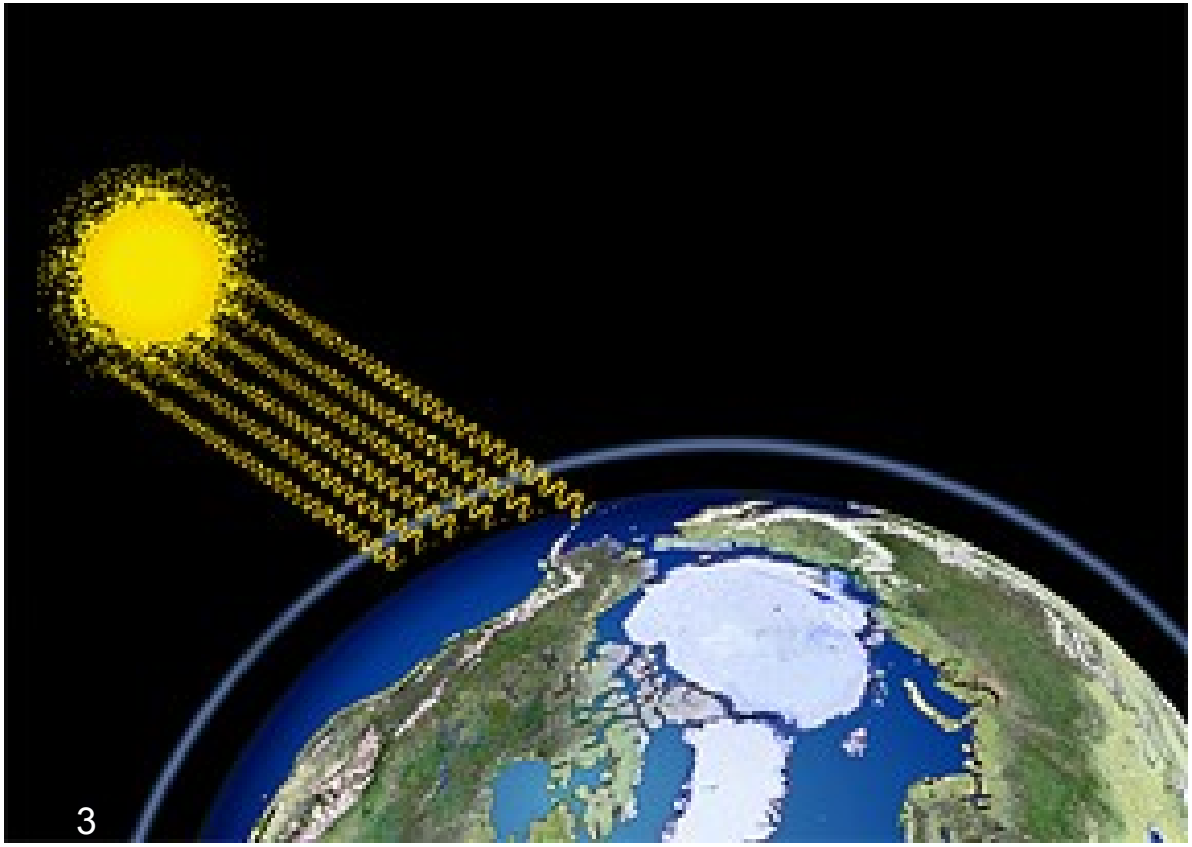
Work Plans for Reducing GHG Emissions

Greenhouse Gas Emission Reduction Task Force
Public Workshops

November 2009

Current Science, Law, and Action

Greenhouse gases trap heat from the sun in the atmosphere. More gases lead to extra warming, climate changes, and problems.



Greenhouse Gases:

Carbon Dioxide (CO_2): gasoline and electric power

Methane (CH_4): landfills & livestock

Others: burning, fertilizer use

Perfluorocarbons (PFC),

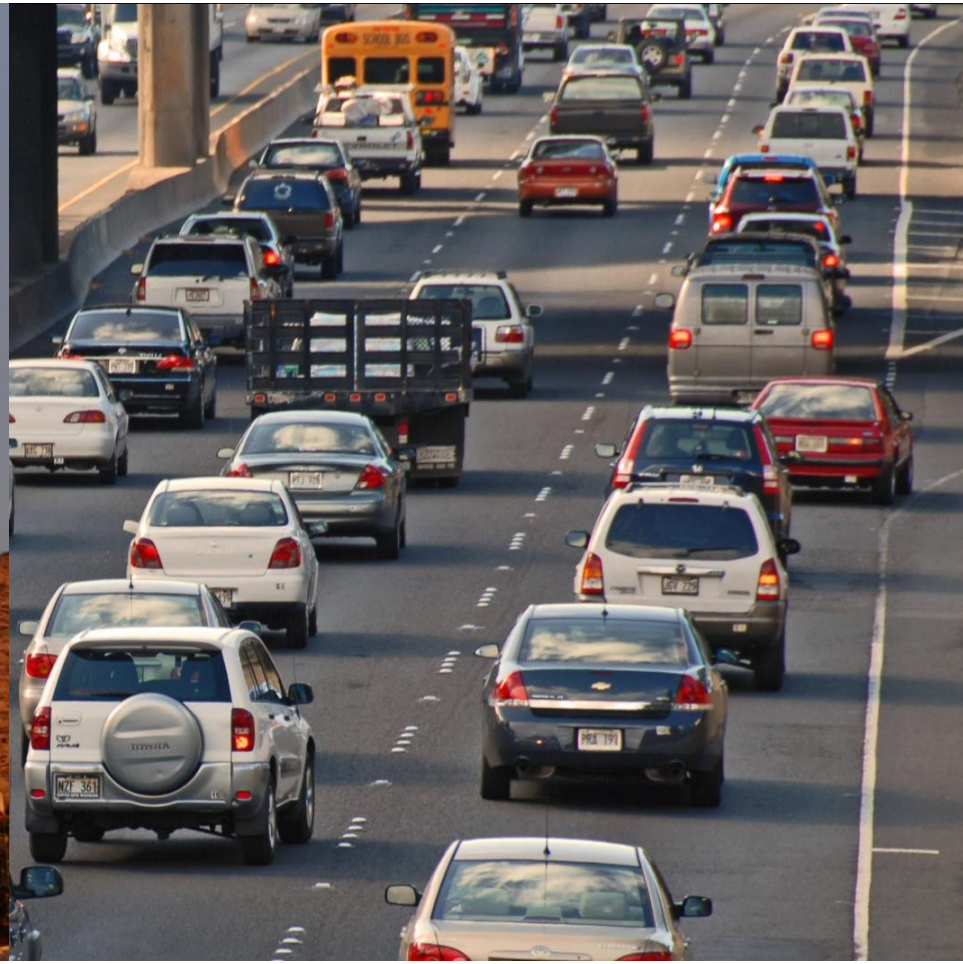
Hydrofluorocarbons (HFC),

Sulfur Hexafluoride (SF_6)

Kilauea volcano emits sulfur dioxide

- not a greenhouse gas

Each Hawaii resident contributes over 17 tons GHG per person



Equivalent of 17 tons

Our everyday contribution to a changing climate

- 1 gallon of gasoline = about 20 pounds GHG
- Typical car = about 1 pound GHG per mile

  = about 4 tons GHG per year

- 1 kilowatt-hour of electricity = about 2 pounds GHG
- Average HI home = about 7.5 tons GHG per year

GHG rise expected to cause or intensify in Hawaii:

- Sea level rise
  - Shore erosion
  - Poor drainage
  - Saltier groundwater
- Sea more acidic
- Sea surface warmer
- Reefs, shellfish weaken

Expected Hawaii Changes - 2

- Weather
  - Rain, temperature, wind
  - More frequent and severe storms
  - Drought
- Water supply
- Forest & crop changes, habitat loss
- Spread of diseases
- Health effects

ACT 234 TARGET

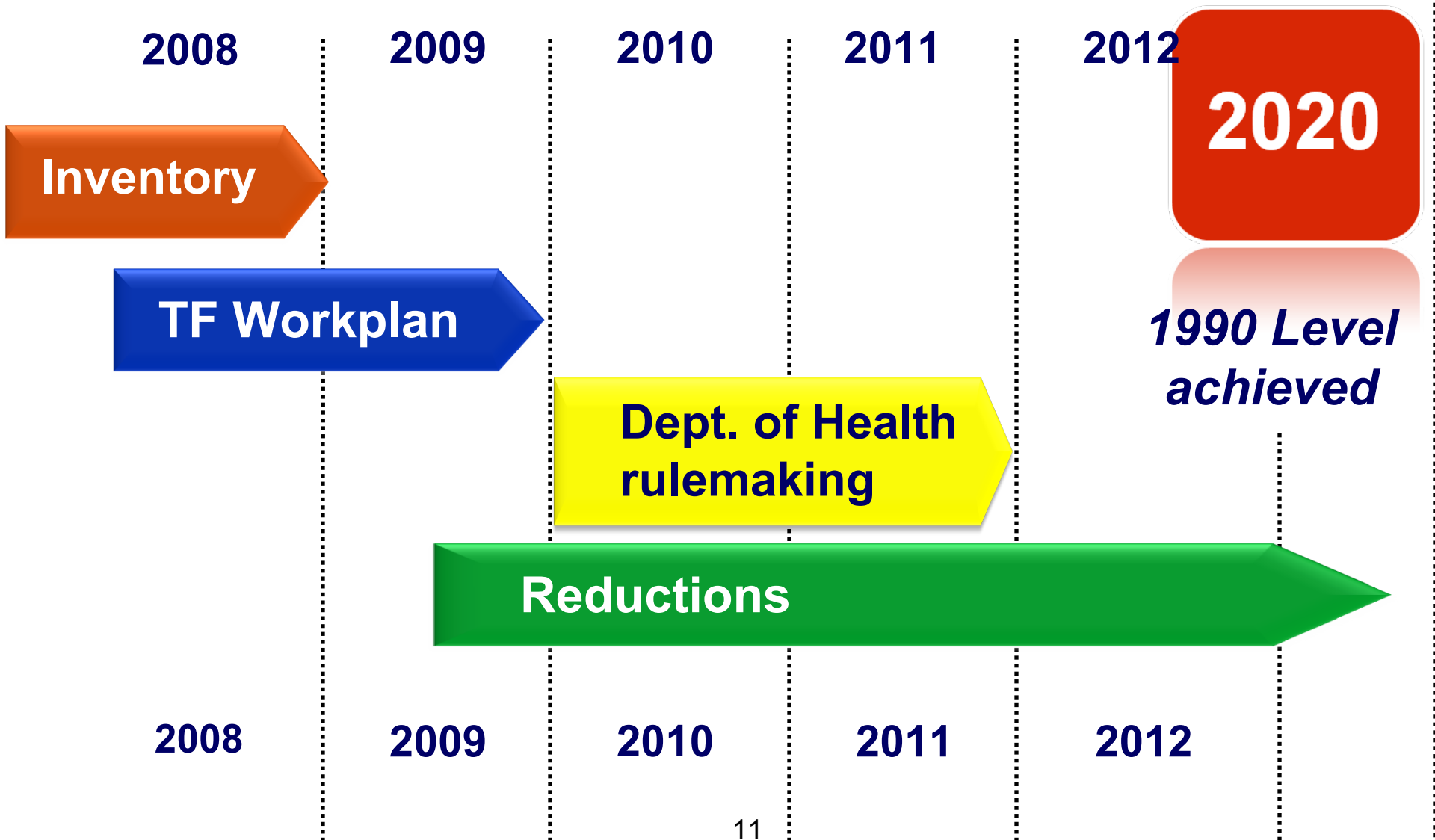
- **GHG EMISSIONS TO 1990 LEVELS BY 2020**

  - About 12% reduction from 2007
  - 1990: 13,660 kt CO2e (carbon dioxide equivalent)
  - 2007: 15,487 kt CO2e

  - excludes aviation & international fuels
  - includes carbon “sinks” ***(e.g. forests, reservoir GHG for indefinite period)***

Global Warming Solutions Act 234

Timeline



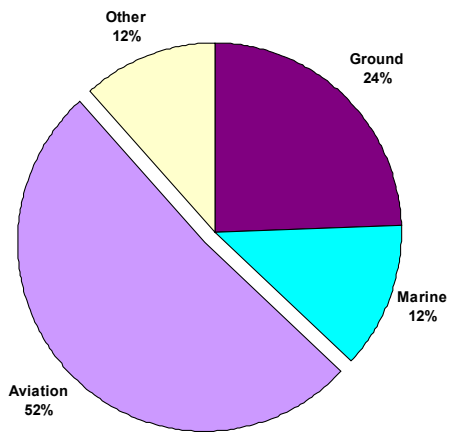
Inventory: Sources

- Energy 90%
- Industrial Processes
- Waste
- Agriculture, Forestry, and Other Land Use

Inventory Transportation Energy Emissions by Source

(Excluding Sinks, Including Aviation) in $MMTCO_2Eq$

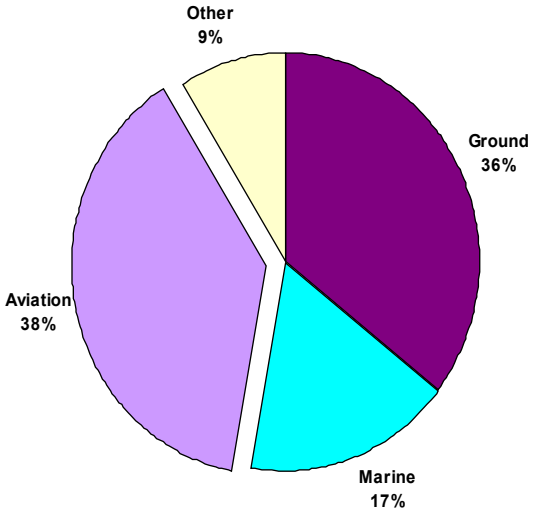
1990 Transportation Energy Emissions



Total Transportation Energy Emissions (*including aviation*) = 13.21 MMTCO2E

Total Transportation Energy Emissions (*excluding aviation*) = 6.41 MMTCO2E

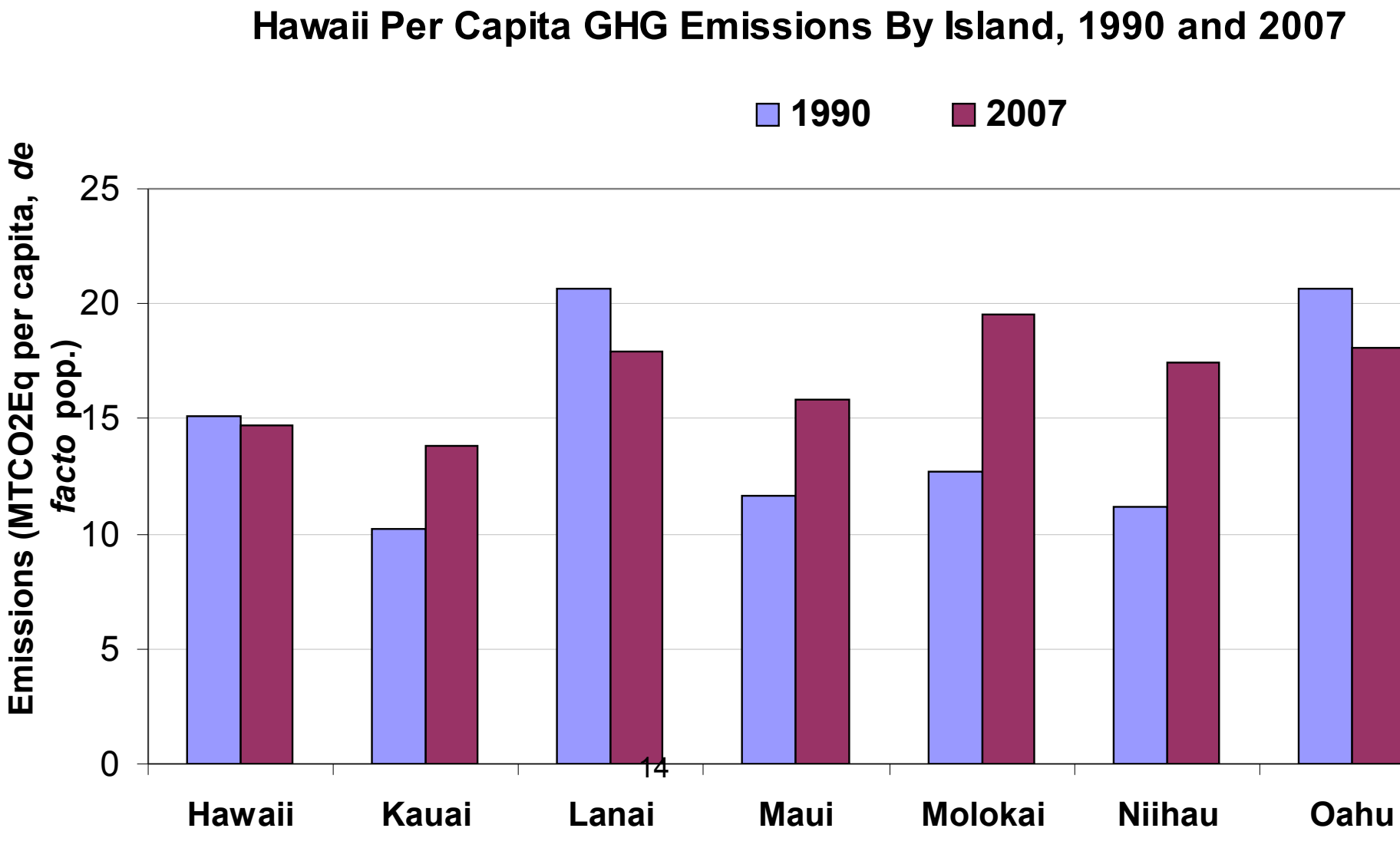
2007 Transportation Energy Emissions



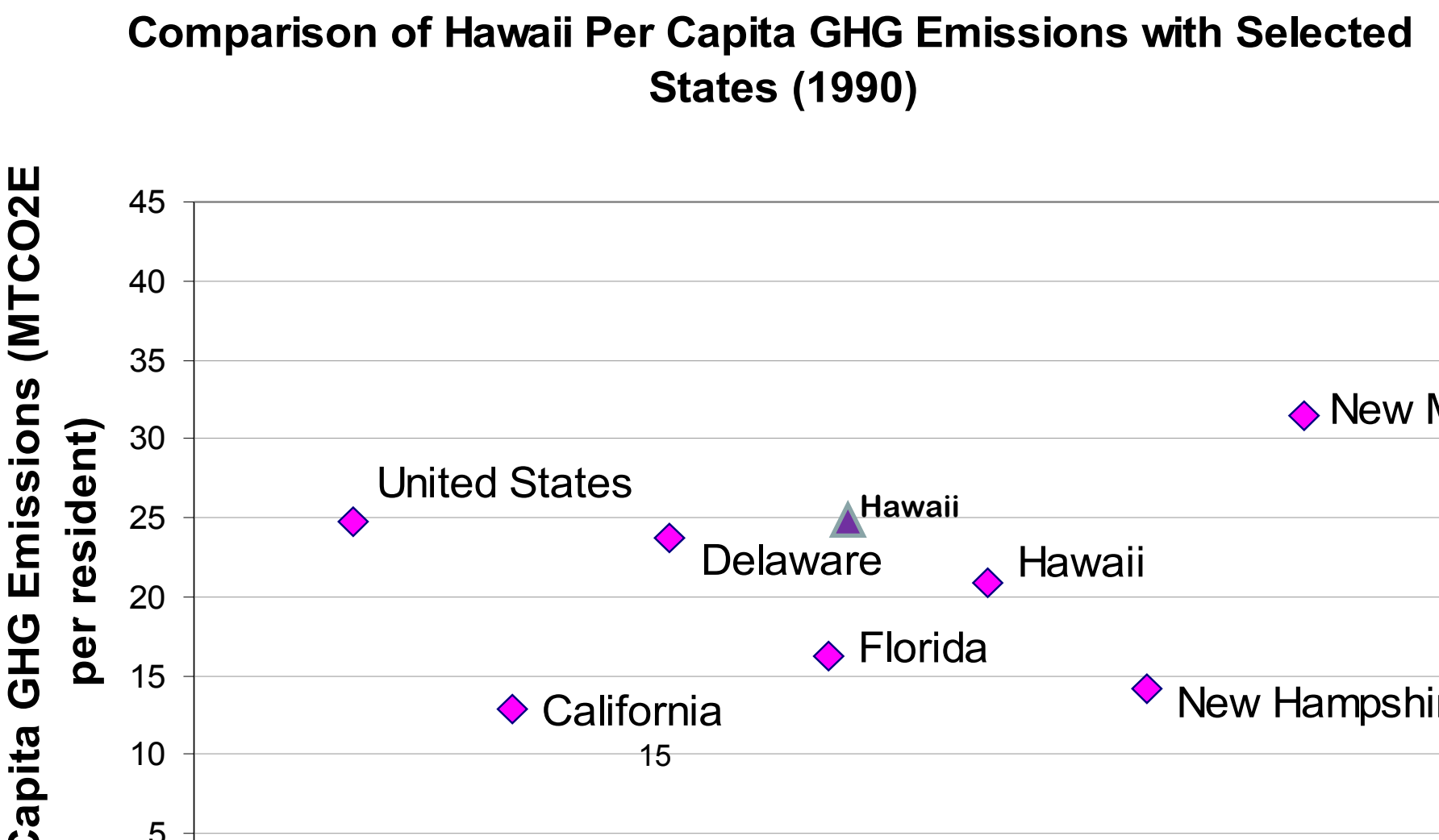
Total Transportation Energy Emissions (*including aviation*) = 12.58 MMTCO2E

Total Transportation Energy Emissions (*excluding aviation*) = 7.75 MMTCO2E

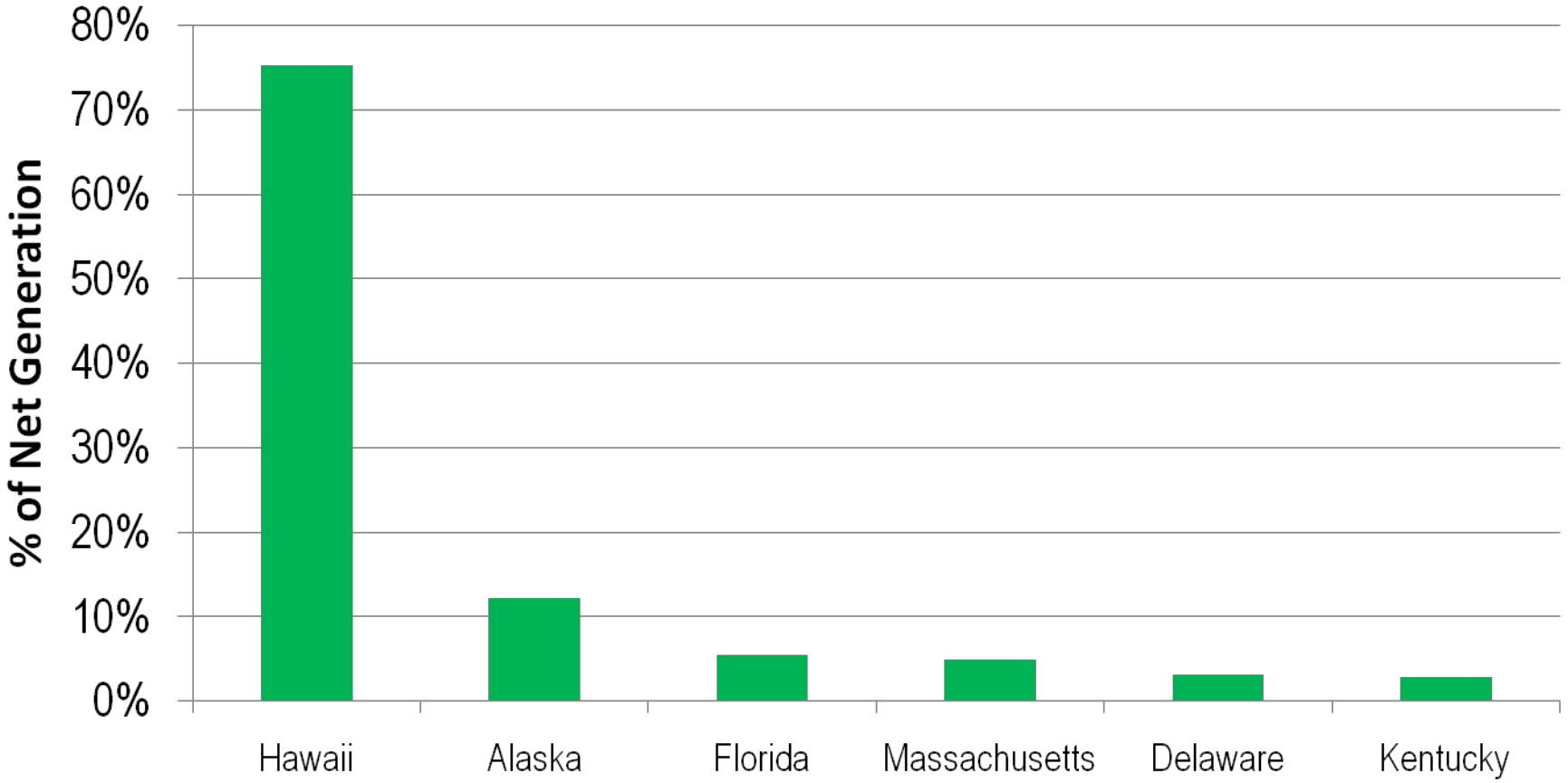
Emissions in Context: Trends
Per person, by Island



GHG emissions per person: Selected States



Hawaii: most petroleum dependent state in U.S.



Source : EIA-923 and EIA-860, December 2008

Petroleum dependence for electricity – top 6 states

We send up to $7 billion a year out of our economy!

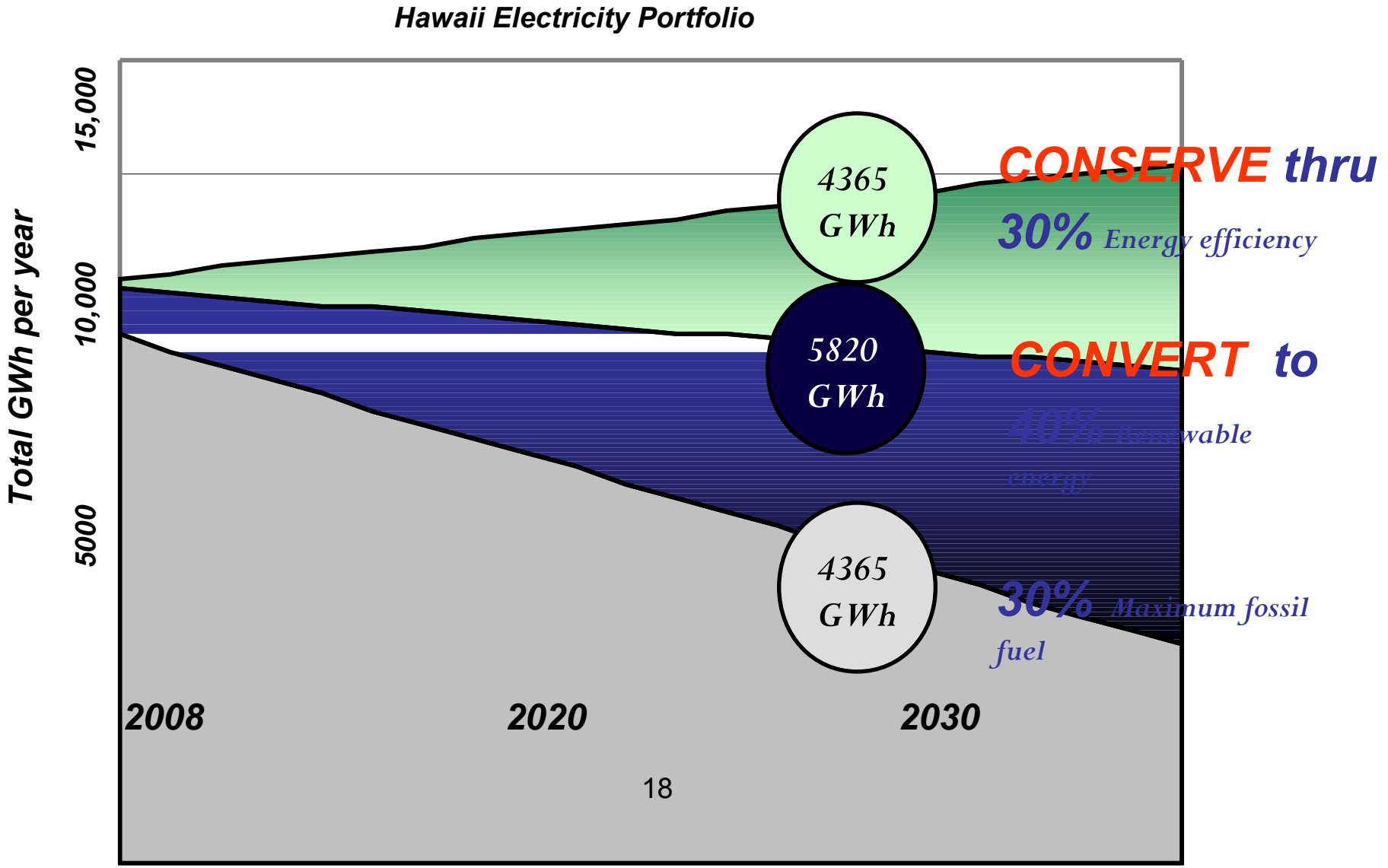
Hawaii Clean Energy Initiative

National Partnership to Accelerate *System* Transformation

The goals are:

- *Achieve a **70% clean energy economy** for Hawaii within a generation*
- *Increase Hawaii's **security***
- *Capture **economic benefits** of clean energy for all levels of society*
- *Foster and demonstrate **innovation***
- *Build the **workforce** of the future*
- *Serve as a **model** for the US and the world*

To reach 70% clean energy by 2030 make it easy to Conserve and Convert



HCEI accomplishments so far

- Partnerships: 100+ citizens & experts

  Transportation, Efficiency, Electricity, Fuels, and Integration work groups

- Agreement with HECO for big changes

  e.g. biofueled power plant, set price for power suppliers, decouple profits from sales, 1100 MW of new renewable generation by 2020 – 40 areas covered

- Partnered with electric car companies

  Better Place & Phoenix MotorCars – working several additional projects as well

- Significant efficiency projects across the state

  DAGS and Hawaii Public Housing Authority Performance Contracts, DOD initiatives,

Hawaii Greenhouse Gas Emissions Reduction Work Plans

Summary of Work Plan Report

- Target: 1990 emissions levels by 2020
  excludes aviation & international fuels, includes sinks
- Reference Case hits target if all items met on time;
  includes existing laws & policies.
- All 3 work plans include Hawaii Clean Energy Initiative plus other policies (HCEI+).
- HCEI+ & all work plans, if met on time, reduce emissions about 39% below target.

Summary of Work Plan Report – 2 Work Plans

- #1 HCEI+: large emission reductions, if met on time
- #2 State carbon tax: small reductions beyond HCEI+ but may fund programs.
  - Includes & assumes HCEI+ is met on time.
- #3 Federal Cap-and-Trade system: small reductions beyond HCEI+, and very uncertain.
  - Unclear what Congress will do, or when
  - Includes & assumes HCEI+ is met on time

Reference Case – Highlights

- ‘Business as usual’ projection

- Population growth ~1.1% per year
- Economy increase ~2.3% per year (Gross Regional Product or GRP)

- Lower energy use per household and per $ output
  - Increased efficiency
- GHG emissions decline slightly (-1.3% per year)
  - Increased efficiency and renewable energy use.
- Highway & power emissions decline as a share of total.

Reference Case - Emissions

GHG Emissions *(kt)*	1990	2007	2010	2015	2020	Avg. Annual Growth Rate 2007-2020
Residential	30	66	63	64	66	*0.0%*
Commercial	380	329	329	327	315	*-0.4%*
Industrial	880	637	650	649	635	*0.0%*
Passenger - Residents	3,230	2,918	2,534	2,185	1,819	*-3.6%*
Passenger - Visitors	n/a	453	331	271	211	*-5.7%*
Marine	1,650	2,173	2,182	2,184	2,135	*-0.1%*
Aviation	6,800	4,839	5,075	5,180	5,167	*0.5%*
Freight	1,530	1,402	1,298	1,240	1,204	*-1.2%*
Power Sector	6,790	8,745	7,957	7,545	7,684	*-1.0%*
Waste	850	1,032	1,143	1,209	1,320	*1.9%*
Agriculture & Forestry	*(1,690)*	*(2,267)*	*(2,267)*	*(2,266)*	*(2,266)*	*0.0%*
Total	***20,450***	***20,326***	***19,294***	***18,588***	***18,289***	***-0.8%***
Targetted Emissions	***13,660***	***15,487***	***14,219***	***13,408***	***13,123***	***-1.3%***

- Emissions in target = 13.66 Mt CO2e in 1990.
- Reference case target emissions = 13.1 Mt CO2e by 2020
  or 4% below 1990 levels
- ***State target is met if Reference Case is met on time***

Work Plans' Background

- Act 234 requires certain considerations, excludes aviation
- Assumptions, information, & models are key:
  - energy prices (AEO 2009)
  - economic forecasts (DBEDT 2035 Series)
  - population forecasts (DBEDT 2035 Series)
  - state energy use model ('ENERGY 2020')
  - economic impacts model ('REMI')
- Emissions changes for each policy are only estimates
  - *do not account for interactions between policies.*

GHG Reduction Policies Included in Work Plans

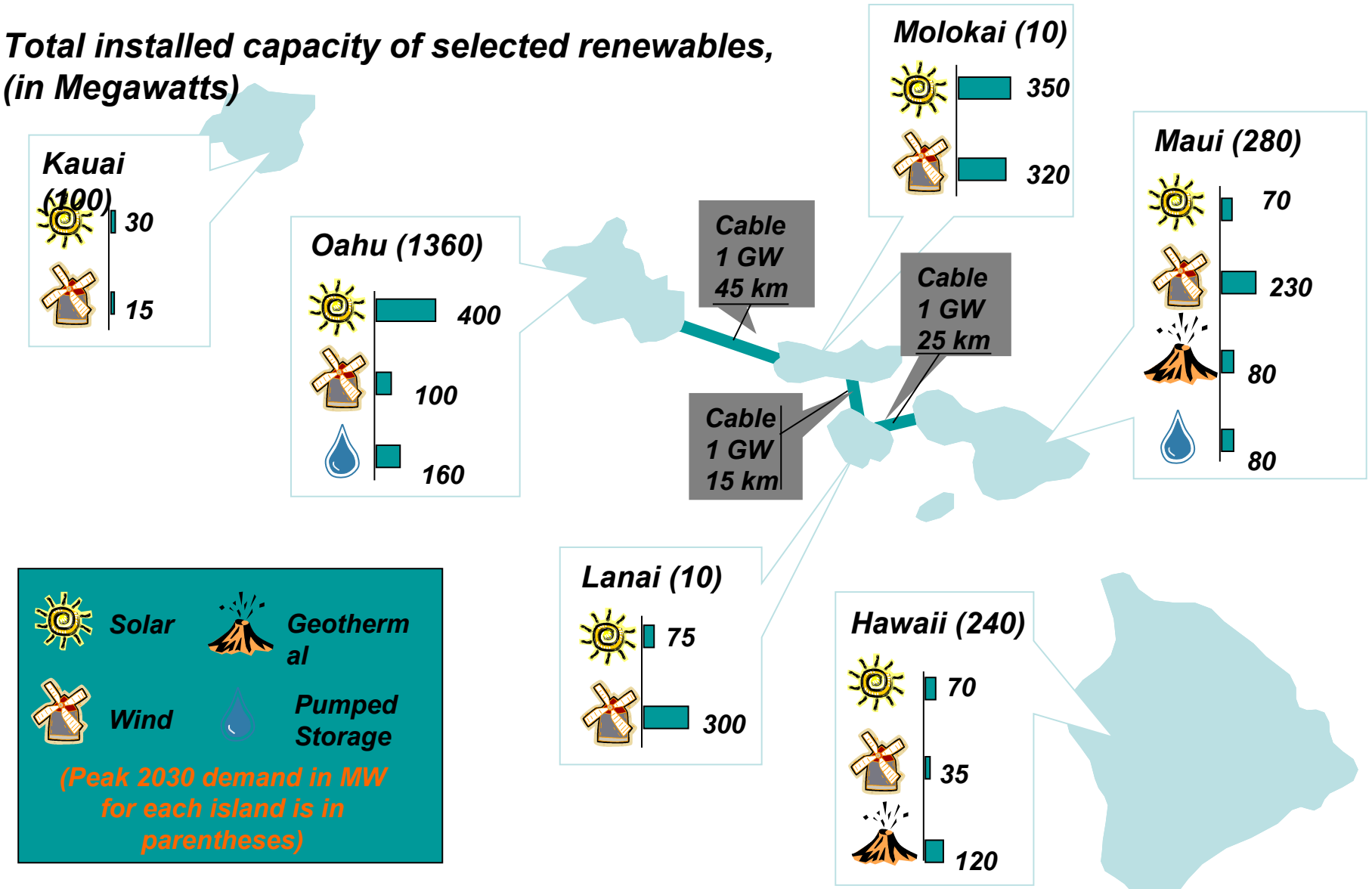
Work Plan 1: HCEI + Additional Policies

	Policy	Description	CO2e Reduction in 2020 (estimated, & when done alone)
HCEI			
	Additional Renewable Generation and use of Biodiesel to Fuel Power Plants	per HCEI Energy Agreement	4,490 kt
	Sea Water Cooling	2 projects- Waikiki/Honolulu	126 kt
	Plug in Hybrid Electric Vehicles (PHEV's)	2010 start - reaching 2% of new vehicles by 2020	56 kt
Additional Policies			
	Renewable Portfolio Standard (RPS)	25% electricity sales by 2020 (5% above Reference Projection)	244 kt
	Energy Efficiency Portfolio Standard (EEPS)	20% reduction by 2020	1,580 kt
	Increased Vehicle Efficiency	Average new vehicle efficiency rise from 35.5 mpg in 2016 to 42.4 by 2020	27 kt
	Building Codes	2010- 30% over current 2014- 50% over current then 5% every 3 years	715 kt

Note- Freight options and Land Use Planning recommended but not included in modeling.

Major HCEI Renewable & Biofuel prospects, in 2030

Total installed capacity of selected renewables, (in Megawatts)



Source: *Team analysis*

A Few Examples of Major HCEI Renewable Energy Projects

Project	Description		*Estimated Completion Target*
Wind Farms, Lanai & Molokai	200 MW renewable energy each		*2013*
Wind Farm,	200 MW renewable energy		*2013*
Undersea cable	Lanai, Molokai, Oahu (Maui possibly, later)		*2013*
Other Projects (for all HECO companies)	169 MW (non-utility) 308 MW (utility-owned)		*2020* *2015 (including biofuels)*

Work Plan 1: HCEI + Additional Policies

- Most reductions - from HCEI & electricity efficiency (EEPS)
- Renewable (RPS), alternative fuel (AFS), and vehicle standards reductions are relatively small through 2020
  - Most items already in Reference Case.
- Some items have stronger effects after 2020:
  - Building code update
  - PHEV's (plug in hybrid electric vehicles)
  - Land uses (Urban Form/Smart Growth)

Work Plan 1, Emissions in 2020 (kt CO2e)

Industry	Reference Case @ 2020	Work Plan 1 @ 2020	Change from Reference Case @ 2020
Residential	66.1	62.2	-3.9
Commercial	314.5	299.3	-15.3
Industrial	635.0	663.3	28.4
Passenger-Residents	1,818.5	1,593.7	-224.8
Passenger- Visitors	211.1	185.3	-25.8
Marine	2,135.2	2,145.2	9.9
Aviation	5,166.9	5,191.2	24.4
Freight	1,203.8	1,098.7	-105.1
Power Sector	**7,683.6**	**3,268.8**	**-4,414.9**
Waste	1,320.4	1,324.6	4.3
Agriculture & Forestry	-2,265.8	-2,263.7	2.1
Total	18,289.3	13,568.6	-4720.7
Total, Excluding Aviation	**13,122**	**8,377**	**-4,745**
Differ from Target (13,660 kt CO2e)	**-538**	**-5,283**	

Work Plan 2: State Carbon Tax + HCEI+

- State tax, not federal
- $10/tonne in 2010 moving to $40/tonne CO2e by 2020.
- Emissions depend on tax amount & relative levels of energy efficiency.
- Assumes HCEI+ is met on time.

- all sectors
- all fossil fuels based on carbon content of each fuel
- excludes non-energy emissions or feedstocks
- price certainty, not compliance certainty
- subject to same market imperfections as any other price signal
- tax similar to likely permit prices from proposed federal C&T

Work Plan 2, Carbon Tax Modeling Results

- Emissions reduction small next to & because of HCEI+
  (<50kt vs 4,800 kt CO2e)

- Revenue: ~$200M (2010) to ~$870M (2020) per year.
  (*Approximate amount raised by a tax before return via tax system*)

- Could finance HCEI+, energy efficiency, adaptation to climate change effects on infrastructure and environment.

- To reduce negative effects
  - Assumed return of 90% through tax system.
    (Scenarios of keeping 100%, other %s, NOT modeled)
  - Could cut other taxes (revenue neutral),
  - Could help low income families and people.

Work Plan 3: Federal Cap & Trade + HCEI+

- *C&T = Total tons capped, cap declines over time; need permit to emit each ton; some permits free, some auctioned; can buy/sell permits.*
- Work plan uses House bill passed this year

  American Clean Energy and Security Act (aka ACES or Waxman-Markey)
- Target: 17% below 2005 covered sectors by 2020
- Coverage:
  - 2012 - Electricity sector and Petroleum Refining

    = ~90% Hawaii emissions
  - 2014 - Other industrial sectors
  - 2016 - Gas LDC's (Local Distribution Companies) and virtually all fossil fuel energy will be covered.
- Prices assumed: $20/tonne (2012) to $35/tonne (2020).

Work Plan 3, Cap & Trade Modeling Results

- Emissions reduction small next to & because of HCEI+ (~ 20kt C&T vs. 4,800 kt HCEI+ reduction).

- Net cost of buying federal permits
  ~$212 million in 2012,
  ~$154 million in 2020 as emissions decline.

- Cost to HI = required - free permits
  - Required permits decrease
    - from ~18 Mt in 2012, to ~14 Mt CO2e by 2020.
  - Free permits = 8.8 Mt + ~0.2 for refineries & coal plant.

- Net cost = about 0.2% of projected HI GRP in 2020.

Work Plans Comparison
Electricity & energy prices & bills

Summary of Work Plan Impacts- Yr 2020 *(changes all from Reference Projection)*	**Work Plan 1 (HCEI +)**	**Work Plan 2 (State Carbon Tax + HCEI+)**	**Work Plan 3 (Federal Cap & Trade + HCEI+)**
Change in average home electricity bill	**~20% decrease**	**~20% decrease**	**~20% decrease**
Increase in electricity prices	**22-24%**	**25-28%**	**21-23%**
Change in other fossil fuel energy prices (including diesel fuels, oil & bottled gas)	**No change**	**5-6% Increase**	**7-8% Increase**

- Consumer electricity costs decline despite price rise, as efficiency reduces use.
- Non-electricity costs (e.g. gasoline, food, etc.) likely to increase if fuel costs increase significantly (i.e., carbon tax, C&T)

Hawaii Economic Impact of Work Plans Comparison

Summary of Work Plan Impacts on Hawaii Economy- Yr 2020 *(changes all from Reference Projection)*	Work Plan 1 (HCEI +)	Work Plan 2 (State Carbon Tax + HCEI+)	Work Plan 3 (Federal Cap & Trade + HCEI+)
Gross Regional Product	0.3%	0.3%	0.9%
Real Disposable Income	0.4%	0.4%	1.1%
Total Population	0.1%	0.1%	0.6%
Total Employment	0.3%	0.4%	0.9%
Commercial Employment	0.2%	0.3%	0.8%
Industrial Employment	7.0%	7.0%	7.0%
Forestry & Agriculture Employment	0.0%	0.0%	2.3%
Utility Employment	-16.7%	-13.3%	-16.7%

Work Plans – Summary of Results

- Emission reductions do not vary much between plans.
- Most reduction is from Plan #1, HCEI+, if met on time.

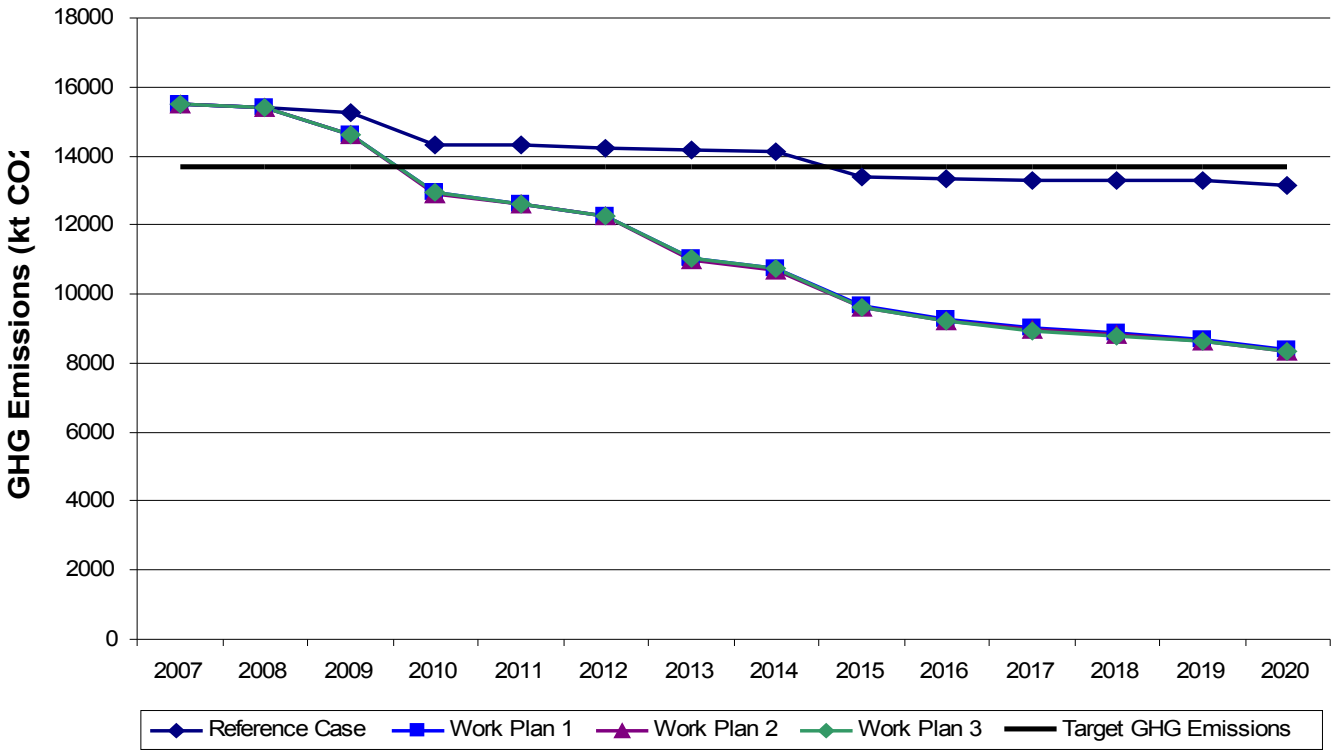
- Plans #2 & 3 differ from #1 in negative effects on energy costs and the Hawaiian economy, including cost of living and increased cost burden on small businesses.
- Plan #2 (Carbon Tax + HCEI+) sends a stronger price signal and provides funds for State.
- Plan #3 (C&T + HCEI+) sends some funds from Hawaii to federal system.
  - Net effect depends on Hawaii's share of "permit funded" program spending.

GHG Emissions Changes Under Work Plans

Target: 13,660 kt CO2e 2007: 15,487 kt CO2e

Work Plan or case	Description	Emissions in 2020 (CO2e)	Amount Below 1990 Target CO2e	% Below 1990 Target Level
Work Plan 1	HCEI & added proposed policies are met on time	8,377 kt	5,280 kt	38.7%
Work Plan 2	State Carbon Tax used w/ Work Plan 1	8,327 kt	5,330 kt	39.0%
Work Plan 3	Federal Cap & Trade system used with Work Plan 1	8,324 kt	5,340 kt	39.1%
Reference Case	Existing laws & policies met on time	13,122 kt	538 kt	4.0%

Hawaii's Targeted GHG Emissions Under Work Plans



1) Graph includes all emissions. **All Work Plans, plus Reference case, meet Act 234 target.**
2) All work plan emissions fall far below reference case.
3) **Differences between work plans are slight given the big differences from reference levels**

Questions or Comments?

- Email comments by Dec. 1, 2009 for Task Force consideration

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